CLAIMS

What is claimed is:

1. A noise source evaluation system comprising:

a design of an assembly, said design including a plurality of representative data points;

a point selection subsystem that selectively identifies a subset of representative data points; and

a point evaluation subsystem that identifies a noise source characteristic in said design using said subset of representative data points.

2. A noise source evaluation system as recited in claim 1, wherein said noise source characteristic is a buzz, squeak, or rattle.

3. A noise source evaluation system as recited in claim 1, further comprising a plurality of models representing the design.

4. A noise source evaluation system as recited in claim 3, further comprising a critical data point.

5. A noise source evaluation system as recited in claim 4, wherein the plurality of models includes a restored model and wherein the critical data point is restored.

6. A noise source evaluation system as recited in claim 5, wherein the restored model is generated using a degraded model or an as-designed model.

7. A noise source evaluation system as recited in claim 3, wherein the plurality of models includes an as-designed model representing the design of an assembly before the assembly is aged.

8. A noise source evaluation system as recited in claim 3, wherein the plurality of models includes a degraded model representing the design of an assembly after the assembly is aged.

9. A noise source evaluation system as recited in claim 8, wherein the degraded model is generated from an as-designed model.

10. A noise source evaluation system as recited in claim 3, further comprising a first critical data point, the plurality of models comprising:

an as-designed model, representing the design of the assembly before the assembly is used; and

a degraded model, representing the design of the assembly after the assembly is used.

11. A noise source evaluation system as recited in claim 10, wherein the point selection subsystem selectively identifies a subset of representative data points for each model.

12. A noise source evaluation system as recited in claim 11, wherein the first critical data point is selectively identified from the subset of representative data points for the degraded model by the point evaluation subsystem.

13. A noise source evaluation system as recited in claim 12, wherein the as-designed model further includes a representation of a fastener.

14. A noise source evaluation system as recited in claim 13, wherein the representation of a fastener in the as-designed model is degraded in the degraded model.

15. A noise source evaluation system as recited in claim 13, wherein the representation of a fastener includes a representation of a bolt.

16. A noise source evaluation system as recited in claim 15, wherein the representation of a bolt includes a torque retention capability.

17. A noise source evaluation system as recited in claim 16, wherein the torque retention capability is reduced in the degraded model.

18. A noise source evaluation system as recited in claim 13, wherein the representation of a fastener includes a representation of a snap.

19. A noise source evaluation system as recited in claim 18, wherein the representation of a snap including an elastic stiffness.

20. A noise source evaluation system as recited in claim 19, wherein the elastic stiffness is reduced in the degraded model.

21. A noise source evaluation system as recited in claim 12, the plurality of models further comprising a restored model, the restored model including a second critical data point that is selectively identified from the subset of representative data points in the restored model after the first critical data point is restored.

22. A noise source evaluation system as recited in claim 1, the design including a plurality of fastener representations, wherein each fastener representation comprises a representative data point in the subset of representative data points.

23. A noise source evaluation system as recited in claim 22, including a pair of representative data points, wherein each fastener representation comprises a pair of representative data points in the subset of representative data points.

24. A noise source evaluation system as recited in claim 23, including a pair of squeak data points, wherein the pair of representative data points are the pair of squeak data points.

25. A noise source evaluation system as recited in claim 23, including a pair of rattle data points, wherein the pair of representative data points are the pair of rattle data points.

26. A noise source evaluation system as recited in claim 22, the design including a plurality of non-fastener locations, wherein a subset of the non-fastener locations are selectively identified in the subset of representative data points.

27. A noise source evaluation system as recited in claim 26, wherein the subset of non-fastener locations are selectively identified on the basis of a threshold distance between non-fastener locations.

28. A noise source evaluation system as recited in claim 27, including a pair of representative data points in the subset of representative data points, wherein the subset of non-fastener locations comprise the pair of representative data points.

29. A noise source evaluation system as recited in claim 28, including a pair of rattle data points, wherein the pair of representative data points are the pair of rattle data points.

30. A noise source evaluation system as recited in claim 28, including a pair of squeak data points, wherein the pair of representative data points are the pair of squeak data points.

31. A noise source evaluation system as recited in claim 31, including a mode and a buzz data point included in the subset of representative data points, the buzz point selectively identified from said plurality of representative data points using said mode.

32. A noise source evaluation system as recited in claim 31, the design including a plurality of parts, wherein no part includes more than one buzz data point.

33. A noise source evaluation system as recited in claim 31, including a threshold displacement, wherein the threshold displacement is used to selectively identify the buzz point.

34. A noise source evaluation system as recited in claim 22, wherein the plurality of fastener representations includes a representation of a bolt.

35. A noise source evaluation system as recited in claim 34, including an acceptable bolt representation and a formatted bolt representation, wherein the bolt representation is converted into the formatted bolt representation before the subset of representative data points are selectively identified from representative data points.

36. A noise source evaluation system as recited in claim 22, wherein the fastener representations include a snap representation.

37. A noise source evaluation system as recited in claim 36, including an acceptable snap representation and a formatted snap representation, wherein the snap representation is converted to the formatted snap representation before the subset of representative data points are selectively identified from the representative data points.

38. A noise source evaluation system as recited in claim 1, wherein the noise source characteristic is identified for each data point in the subset of representative data points.

39. A noise source evaluation system as recited in claim 1, including a subset of representative data points further comprising a plurality of pairs of data points, wherein a noise source characteristic is generated for each such pair of data points.

40. A noise source evaluation system as recited in claim 1, including a gap between two representative data points in the subset of representative data points, wherein the gap is used to determine a noise source characteristic.

41. A noise source evaluation system as recited in claim 40, including an environmental deformation, wherein the environmental deformation is incorporated into the gap.

42. A noise source evaluation system as recited in claim 40, wherein the environmental deformation is based upon a thermal load, a gravitational effect or a moisture effect.

43. A noise source evaluation system as recited in claim 40, including a geometric dimensioning and tolerance effect, wherein the geometric dimensioning and tolerance effect is incorporated into the gap.

44. A noise source evaluation system as recited in claim 43, wherein the geometric dimensioning and tolerance effect includes one or more of the following: a part specific variation, a profile variation, and a gap variation.

45. A noise source evaluation system as recited in claim 40, including a dynamic response, wherein the dynamic response is incorporated into the gap.

46. A noise source evaluation system as recited in claim 45, wherein the dynamic response is included in a file that is inputted into the system.

47. A noise source evaluation system as recited in claim 39, including a gap and an environmental effect affecting the gap.

48. A noise source evaluation system as recited in claim 1, the point evaluation subsystem including a buzz evaluation module, a buzz characteristic, and a displacement, wherein the displacement is used to generate the buzz characteristic.

49. A noise source evaluation system as recited in claim 48, wherein the displacement is expressed as a frequency domain displacement and a time domain displacement, the frequency domain displacement is transformed into the time domain displacement, and the time domain displacement is used by the buzz evaluation subsystem to generate the buzz characteristic.

50. A noise source evaluation system as recited in claim 49, including a Fast Fourier transformation for transforming the frequency domain displacement into the time domain displacement.

51. A noise source evaluation system as recited in claim 48, including an absolute integral of a buzz curve over a time period, wherein the buzz characteristic is an absolute integral of a buzz curve over a time period.

52. A noise source evaluation system as recited in claim 48, including a maximum magnitude of a buzz curve, wherein the buzz characteristic is a maximum magnitude of a buzz curve.

53. A noise source evaluation system as recited in claim 48, including a weighted average of a maximum magnitude of a buzz curve and an absolute integral of a buzz curve over a period of time, wherein the buzz characteristic comprises the weighted average of the maximum magnitude of a buzz curve and the absolute integral of a buzz curve over a period of time.

54. A noise source evaluation system as recited in claim 48, further including a plurality of buzz data points and a plurality of buzz characteristics, wherein each buzz data point has a buzz characteristic, and each buzz data point is ranked by a magnitude of the buzz characteristic corresponding to the buzz data point.

55. A noise source evaluation system as recited in claim 54, further including a critical buzz data point, wherein the buzz data point is identified as a critical buzz data point.

56. A noise source evaluation system as recited in claim 54, further comprising a buzz displacement threshold, wherein the buzz data points with buzz characteristics below the buzz displacement threshold are ignored.

57. A noise source evaluation system as recited in claim 1, the point evaluation subsystem including a rattle evaluation module, a rattle characteristic, and a potential penetration, wherein the potential penetration is used to generate the rattle characteristic.

58. A noise source evaluation system as recited in claim 57, wherein the potential penetration is expressed as a frequency domain displacement and a time domain displacement, wherein the frequency domain deflection is transformed into the time domain displacement and the time domain displacement is used by the rattle evaluation module to generate the rattle characteristic.

59. A noise source evaluation system as recited in claim 58, wherein a Fast Fourier transformation is used to transform the frequency domain deflection into the time domain displacement.

60. A noise source evaluation system as recited in claim 58, wherein the rattle characteristic comprises an energy loss, a loss of momentum, or a contact velocity.

61. A noise source evaluation system as recited in claim 58, wherein the rattle characteristic comprises a weighted average of an energy loss and a contact velocity.

62. A noise source evaluation system as recited in claim 58, wherein the rattle characteristic comprises a weighted average of an energy loss and a loss of momentum.

63. A noise source evaluation system as recited in claim 58, further including a plurality of rattle characteristics and a plurality of rattle pairs, each rattle pair comprising two data points from the subset of representative data points, wherein each rattle pair corresponds with a rattle characteristic, and each rattle data pair is ranked by a magnitude of the rattle characteristic corresponding to the rattle data pair.

64. A noise source evaluation system as recited in claim 63, further including a critical rattle data pair, wherein the rattle pair is identified as a critical rattle pair.

65. A noise source evaluation system as recited in claim 1, the point evaluation subsystem including a squeak evaluation module, a squeak characteristic, and a displacement, wherein the displacement is used to generate the squeak characteristic.

66. A noise source evaluation system as recited in claim 65, the displacement comprising a rotational displacement or an in-plane translational displacement.

67. A noise source evaluation system as recited in claim 65, the squeak characteristic comprising a rotational squeak characteristic or a translational squeak characteristic.

68. A noise source evaluation system as recited in claim 65, wherein the displacement is expressed as a frequency domain displacement and a time domain deflection, wherein the frequency domain displacement is transformed into the time domain displacement and the time domain displacement is used by the squeak evaluation subsystem to generate the squeak characteristic.

69. A noise source evaluation system as recited in claim 68, wherein a Fast Fourier transformation is used to transform the frequency domain displacement into the time domain displacement.

70. A noise source evaluation system as recited in claim 65, including an area of interference, wherein the squeak characteristic comprises an area of interference.

71. A noise source evaluation system as recited in claim 65, including a maximum interference, wherein the squeak characteristic is a maximum interference.

72. A noise source evaluation system as recited in claim 65, including a weighted average of an area of interference and a maximum interference, wherein the squeak characteristic comprises a weighted average of the area of interference and the maximum interference.

73. A noise source evaluation system as recited in claim 65, further including a plurality of squeak characteristics and a plurality of squeak pairs, each squeak pair comprising two data points from the subset of representative data points, wherein each squeak pair corresponds with a squeak characteristic, and each squeak pair is ranked by the magnitude of the squeak characteristic corresponding to the squeak pair.

74. A noise source evaluation system as recited in claim 73, further including a critical squeak pair, wherein the squeak pair is identified as the critical squeak pair.

75. A noise source evaluation system as recited in claim 1, further comprising a plurality of bolts, a subset of critical bolts, and a bolt evaluation subsystem, wherein the subset of critical bolts are selectively identified from the plurality of bolts by the bolt evaluation subsystem.

76. A noise source evaluation system as recited in claim 75, further comprising a force response, a bolt stress, and a bolt index, wherein the force response and the bolt stress determine the bolt index.

77 A noise source evaluation system as recited in claim 1, further comprising a plurality of snaps, a subset of critical snaps, and a snap evaluation module, wherein the subset of critical snaps are selected from the plurality of snaps by the snap evaluation module.

78. A noise source evaluation system as recited in claim 77, further comprising a frequency displacement, a snap stiffness, and a snap index, wherein the frequency displacement and the snap stiffness determine the snap index.

79. A noise source evaluation system as recited in claim 1, including an index strategies module and a magnitude attribute, wherein the index strategies module uses a magnitude attribute to identify the noise source characteristic.

80. A noise source evaluation system as recited in claim 79, wherein the magnitude attribute includes at least one of the following:

an energy loss due to impact;
a loss of momentum at first impact;
a weighted average of said energy loss and said loss of momentum;
an area of interference;
an area of interference over a time period;
a Von Misses stress equivalent
a torque; or
a resultant force.

81. A noise source evaluation system comprising:

a plurality of models representing a design of an assembly, each model including a plurality of representative data points, the plurality of models including:

an as-designed model, representing the assembly before the assembly is affected by use, the as-designed model including a subset of representative data points;

a degraded model, representing the assembly after the assembly is affected by suffers use, including a selectively identified first critical point;

a restored model, representing the degraded model and the as-designed model after the first critical point is enhanced, the restored model including a selectively identified second critical point;

a point selection subsystem, including a point selection heuristic, wherein the point selection subsystem applies the point selection heuristic to selectively identify the subset of representative data points from the plurality of representative data points; and

a point evaluation subsystem, including a point evaluation heuristic and a noise source characteristic, wherein each representative data point in the subset of representative data points is subjected to a heuristic to generate a noise source characteristic.

82. A noise source evaluation system as recited in claim 81, the design models representing the assembly include a plurality of fasteners, a plurality of fastener locations, and a plurality of non-fastener locations;

wherein the plurality of points are comprised of the plurality of fastener representations and the plurality of non-fastener locations; and

wherein each fastener representation is located at a particular fastener location.

83. A noise source evaluation system as recited in claim 82, wherein each fastener location is included in the subset of representative data points.

84. A noise source evaluation system as recited in claim 82, wherein only a subset of non-fastener locations are included in the subset of representative data points.

85. A noise source evaluation system as recited in claim 82, wherein the point selection heuristic selectively identifies non-fastener locations using a distance between non-fastener locations.

86. A noise source evaluation system as recited in claim 81, further including a gap between two representative data points included in the subset of representative data points, wherein the gap determines the noise source characteristic.

87. A noise source evaluation system as recited in claim 81, wherein the noise source characteristic corresponding to the as-designed model is compared to the noise source characteristic corresponding to the restored model.

88. A method for predicting noise source characteristics of a design of an assembly, the method comprising:

providing a design of an assembly;

dividing the design into a plurality of representative data points;

selecting a subset of representative data points from the plurality of representative data points; and

generating a noise source characteristic for each representative data point included in the subset of representative data points.

89. A method for predicting noise source characteristics as recited in claim 88, including modifying the representation of fastener characteristics.

90. A method for predicting noise source characteristics as recited in claim 88, including making an initial gap evaluation at fastener and non-fastener squeak and rattle points.

91. A method for predicting noise source characteristics as recited in claim 88, including performing a fastener degradation evaluation.

92. A method of predicting noise source characteristics as recited in claim 91, including computing a fastener restoration evaluation.

93. A method of predicting noise source characteristics as recited in claim 88, including calculating an initial gap correlation based on geometric dimensioning and tolerance data at squeak and rattle points.

94. A method of predicting noise source characteristics as recited in claim 88, further including incorporating environmental loads.